

December 6, 2010

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**SECRETARY, BOARD OF
OIL, GAS & MINING**

Mr. Chris Kierst, Senior Petroleum Specialist
Department of Natural Resources
Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84116

Subject: Water Compatibility Report – Westwater Farms LLC – Harley Dome Number 1
Project No.: 4422.001(10)

Dear Mr. Kierst:

This letter report details the water compatibility modeling completed for mixing produced water from the Westwater Farms injection treatment system with Wingate Ss formation water with emphasis on solubility. The models were built using existing analytical results for each water and the chemical speciation and solubility modeling program Visual MINTEQ, version 2.53; details about the program and model methodology are below.

The following table summarizes the model results:

Westwater Injection Well Chemistry
Table 1: Summary Table

Component	W181 & Injectate Water Mixed	W201 & Injectate Water Mixed
	Mass Precipitated (lb/1000 bbl)	
Ba+2	4.52	9.26
Ca+2	15.44	26.95
CO3-2	23.72	20.59
H4SiO4	0.92	0.20
Mg+2	9.72	0
SO4-2	3.16	6.48
Total =	57.48	63.49
Solids		
	BaSO ₄ (Barite) = 7.77% of solids	BaSO ₄ (Barite) = 9.09% of solids
	Mg ₃ (Si ₂ O ₅)(OH) ₄ (Chrysotile) = 1.14% of solids	CaCO ₃ (Calcite) = 90.62% of solids
	CaMg(CO ₃) ₂ (Dolomite [ordered]) = 91.09% of solids	SiO ₂ (Quartz) = 0.29% of solids
	8.91% (5.12 lb/1000 bbl) of solids insoluble in acid treatment	9.38% (5.96 lb/1000 bbl) of solids insoluble in acid treatment

We have had multiple discussions regarding our scaling issues with Mr. John Ruggeri, Product Manager for Flow Assurance at Baker Petrolite in Houston, Texas. He is recommending that we also add an antiscalant to control our precipitation issues within the formation; however, Baker Petrolite is performing some additional testing in order to identify the best antiscalant product for our application.

The modeling software used in this effort was Visual MINTEQ ver. 2.53. The original program, MINTEQA2 ver 4.0, was written in Fortran 77 and released in 1999 by CEAM, US EPA. It has now been entirely rewritten in Visual Basic, with version 2.53 of Visual MINTEQ compiled in Visual Basic 6.0 on October 24, 2007 by Mr. Jon Petter Gustafsson, KTH, Dept. of Land and Water Resources Engineering, Stockholm, Sweden. The aim of the program is to simulate equilibria and speciation of inorganic solutes in natural waters.

There were three water samples evaluated in this exercise: Westwater injectate water, Wingate Ss formation water sample W181, and Wingate Ss formation water sample W201. Analytical data for injectate water was derived from data that was developed as part of Stewart Environmental's pilot testing program, which took place at the Westwater, Utah site from July 26 to September 10, 2010 (please see Attachment 1). Formation water samples W181 and W201 were drawn from the Wingate Ss formation by Mr. David Allin, Westwater's hydrogeologist, on May 20 and June 10, 2010 respectively. Sample W201 was drawn while UDOGM inspector Mr. Bart Kettle was present at the site on June 10, 2010, and thus is of interest to UDOGM. However, Mr. Allin feels that sample W201 was contaminated by water lost during long string cementing operations, and he feels that sample W181 is much more representative of the Wingate Ss formation water. Thus, both formation water samples were included in this modeling exercise. Both formation water samples were tested by Halliburton on May 22 and June 10, 2010 respectively (please see Attachment 2). Stewart Environmental conducted additional testing on sample W181 for barium, silica, and strontium on August 27, 2010 (please Attachment 3).

To calibrate the solubility models, the data for each water was entered into the program without any mixing (please see Attachment 4). Any solids that precipitated in this step were removed from the water accordingly, because solids will be removed from the injectate by Westwater's pre-injection filtration processes and from the formation water by the formation itself, and because precipitated solids are not directly available for aqueous equilibria reactions.

Next, two mixtures were modeled using results from the first step: injectate water with sample W181 and injectate water with sample W201 (please see Attachment 5). The mixtures were created using a 50 percent/50 percent mix of injectate and formation water, which simulates the injectate/formation water interface and is a conservative estimate of the interface interaction. The speciation of components is listed in a table of saturation indices (please see Attachment 6); note that any compound that shows a saturation index value of zero has begun precipitating out of the water.

It is important to note that these models do not account for the use of an appropriate antiscalant chemical, nor do they account for acid treatments performed on the injection well. Model files (compatible with Visual MINTEQ ver. 2.53) are available for review upon request.

Conclusion:

Based on the chemical modeling and discussions with Baker Petrolite, we will be adding an antiscalant to control precipitation in the well bore. This will likely be a phosphate scale inhibitor and we will also add a biocide to prevent

Mr. Chris Kierst
UDOGM
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any future microbiological growth within the formation. The exact products will be determined by Baker Petrolite as well as the proper dosing of these chemicals.

Sincerely,

STEWART ENVIRONMENTAL CONSULTANTS, INC.



David R. Stewart, PhD, PE
President and CEO

Enc.

4422.001(10)\Westewater Chemical Compatibility_06dec10.ltr

Representative Chemistry of Injected Water After Oil Removal

Parameter	Units	8/12/2010	8/16/2010	8/20/2010	8/25/2010	8/31/2010	9/2/2010	9/9/2010	Average
Inorganics									
Ammonium as N	ppm	10.3	11.4	14.7	12	12	11.4	8.6	11.49
Heterotrophic, Plate Count	MPN/mL		1						1.00
Solids/Total Dissolved (TDS)	ppm	14404	7098	12544	13628	13810	13914	13600	12714.00
Sulfate	ppm	0.657	25.4	17.2	< 5	3.2	3.3	4.5	8.47
Metals									
Aluminum	ppm	0.0916	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.44
Aluminum, dissolved	ppm	< 0.05	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.44
Arsenic	ppm	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.20
Arsenic, dissolved	ppm	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.20
Barium	ppm	46.3	32.8	42.9	45.9	45	40.5	36.3	41.39
Barium, dissolved	ppm	42.1	29.4	36.1	40.2	42	40.3	31.5	37.37
Boron	ppm	10.1	12.6	13.7	14.2	12.9	11.9	13.04	12.63
Boron, dissolved	ppm	9.89	11.3	11.5	12.4	12	11.8	11.8	11.50
Cadmium	ppm	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.03
Cadmium dissolved	ppm	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.03
Calcium	ppm	143	150	180	202	151	141	153	160.00
Calcium, dissolved	ppm	132	134	164	172	137	137	133	144.14
Chromium	ppm	0.0069	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.04
Chromium, dissolved	ppm	< 0.005	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.04
Copper	ppm	0.0102	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.04
Copper, dissolved	ppm	< 0.006	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.04
Iron	ppm	7.67	12.1	4	23.9	8.13	8.23	8.32	10.05
Iron, dissolved	ppm	5.14	6.56	3	15.9	5.72	5.43	1.24	6.14
Lead	ppm	< 0.02	< 0.2	< 0.2	< 0.2	< 0.2	< 0.02	< 0.2	0.15
Lead, dissolved	ppm	< 0.02	< 0.2	< 0.2	< 0.2	< 0.2	< 0.02	< 0.2	0.15
Magnesium	ppm	16.2	20.7	22.8	23.9	18	16.5	19.2	19.61
Magnesium, dissolved	ppm	15.2	18.5	19.4	20.9	16.5	16.3	16.9	17.67
Manganese	ppm	0.514	0.607	0.633	0.648	0.389	0.378	0.52	0.53
Manganese, dissolved	ppm	0.479	0.508	0.536	0.566	3.61	0.36	0.435	0.48
Nickel	ppm	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.05
Nickel, dissolved	ppm	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.05
Potassium	ppm	40.1	38.2	83	86.5	57	51.5	43.3	57.09
Potassium, dissolved	ppm	37.4	35.4	70	76.2	53	51	38.5	51.64
Selenium	ppm	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.20
Selenium, dissolved	ppm	< 0.02	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.17
Silica	ppm	46.8	52.2	58.7	70.7	53	68.6	60.4	58.63
Silica, dissolved	ppm	43.6	48.1	54.1	61.8	64.5	64.4	51.4	55.41
Sodium	ppm	4500	3790	3990	4070	4530	4000	4200	4154.29
Sodium, dissolved	ppm	4140	3430	3370	3590	4210	4060	3740	3791.43
Stronitium	ppm	32.7	25.7	24.3	25.3	29.1	26.8	26.8	27.24
Strontium, dissolved	ppm	30	23	20.8	22.6	27.3	26.7	23.5	24.83
Zinc	ppm	0.068	0.068	0.058	0.062	< 0.05	< 0.05	0.114	0.07
Zinc, dissolved	ppm	0.13	0.141	0.204	< 0.05	0.176	< 0.05	0.107	0.12
Organics									
Oil and Grease	ppm	9	11	16	8				11.00
Total Organic Carbon	ppm	240	190	210	190	270	260	240	228.57

HALLIBURTON

Halliburton Energy Services
The Rockles NWA Regional Laboratory
Grand Junction, CO 81501-3692

Water Analysis Report

Contact Information

Company	West Water Farm	Date Received	5-20/21-10
Reported To	Davis Allin	Date Tested	May 22, 2010
Reported By	Ann Ekx	Tested By	Ann Ekx

Sample Physical Characteristics

Well Name	HD1	Temperature	71 °F
Location	TAC 1720	pH	7.6
Specific Gravity	1.012	Color	Orange
Corrected SG	1.014 at 60°F	Turbidity	None
TDS (calculated)	52763 ppm	Resistivity	0.38 Ω·m

Sample Chemical Characteristics

Anions	Chloride	32600 mg/L	Cations	Total Iron	0.2 mg/L
	Sulfate	360 mg/L		Ferrous Iron	0.6 mg/L
	Bicarbonate	290 mg/L		Potassium	510 mg/L
	Carbonate	0 mg/L		Calcium	1600 mg/L
	Hydroxide	mg/L		Magnesium	1400 mg/L
				Sodium (calculated)	16635 mg/L

General Comments

W181; TAC 1720 Contains foamer 15:25 5-21-10

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HALLIBURTON

Halliburton Energy Services
The Rockies NWA Regional Laboratory
Grand Junction, CO 81501
970) 523-3692

Water Analysis Report

Contact Information

Company	West Water Farms LLC	Date Received	June 10, 2010
Reported To	Engineers David Allin	Date Tested	June 10, 2010
Reported By	Ann Ekx	Tested By	Ann Ekx

Sample Physical Characteristics

Well Name	Harley Dome 1	Temperature	64 °F
Location	JW Perfs 1344-1631'	pH	7.8
Specific Gravity	1.013	Color	Clear
Corrected SG	1.013 at 60°F	Turbidity	None
TDS (calculated)	34378 ppm	Resistivity	0.36 Ω·m

Sample Chemical Characteristics

Anions	Chloride	20600 mg/L	Cations	Total Iron	3.0 mg/L
	Sulfate	580 mg/L		Ferrous Iron	0.6 mg/L
	Bicarbonate	400 mg/L		Potassium	0 mg/L
	Carbonate	0 mg/L		Calcium	1780 mg/L
	Hydroxide	mg/L		Magnesium	330 mg/L
				Sodium (calculated)	11114 mg/L

General Comments

W201; 6-10-10 14:40

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Client: Produced Water Development

Laboratory Report

Attn: SEC Engineering Department

Laboratory ID: S102391505 Sample Name: Harley Dome # 1
Sampled: 6/10/2010 12:40 PM Date Received: 8/27/2010 Matrix: Water Grab Batch No: 10707

Project # 5001-010 BG 001

Analyte	Result	Units	MRL	Method	Date	Analyst	Sent Out	Laboratory
Digest/Total/Prep. Batch	74	Dig #	0	SM 3030 F	8/31/2010	VJF	<input type="checkbox"/>	
Barium	0.232	ppm	0.002	EPA 200.7	9/1/2010	MAG	<input type="checkbox"/>	
Silica	14.7	ppm	0.1	EPA 200.7	9/1/2010	MAG	<input type="checkbox"/>	
Stronitum	50.4	ppm	0.001	EPA 200.7	9/1/2010	MAG	<input type="checkbox"/>	

Results Approved by:



Michael Glavanovich, Laboratory Manager

Date Reported: 12/3/2010



Stewart Environmental Consultants, LLC
3801 Automation Way, Suite 200
Fort Collins, CO 80525

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Westwater Injection Well Chemistry
Formation Water W201 Only: Precipitated Solids

Component	Total dissolved (molal)	% dissolved	Total precipitated (molal)	% precipitated
Ca+2	0.038294	85.83	0.006322	14.17
Cl-1	0.58105	100	0	0
CO3-2	0.00022425	3.426	0.006322	96.574
Fe+2	0.000010744	100	0	0
H+1	0.00021399	100	0	0
Mg+2	0.013574	100	0	0
Na+1	0.48343	100	0	0
SO4-2	0.0060378	100	0	0

Formation Water W181 Only: Precipitated Solids

Component	Total dissolved (molal)	% dissolved	Total precipitated (molal)	% precipitated
Ba+2	1.9004E-06	100	0	0
Ca+2	0.037733	94.443	0.0022202	5.557
Cl-1	0.91953	100	0	0
CO3-2	0.00030433	6.414	0.0044403	93.586
Fe+2	0.000010744	100	0	0
H+1	0.00029557	100	0	0
K+1	0.013043	100	0	0
Mg+2	0.055397	96.147	0.0022202	3.853
Na+1	0.72358	100	0	0
SO4-2	0.0037476	100	0	0

Injectate Water Only: Precipitated Solids

Component	Total dissolved (molal)	% dissolved	Total precipitated (molal)	% precipitated
Ba+2	0.00019395	71.28	0.000078145	28.72
Ca+2	0.00087575	24.351	0.0027206	75.649
Cl-1	0.18334	100	0	0
CO3-2	0.0084924	73.382	0.0030805	26.618
Fe+2	6.6611E-06	6.059	0.00010328	93.941
H+1	0.0086582	100	0	0
H3BO3	0.0010638	100	0	0
H4SiO4	0.00010925	11.844	0.00081318	88.156
K+1	0.0013206	100	0	0
Mg+2	0.00059402	81.731	0.00013278	18.269
Mn+2	3.2487E-06	37.182	5.4885E-06	62.818
Na+1	0.16492	100	0	0
NH4+1	0.00067466	100	0	0
SO4-2	0.000010028	11.373	0.000078145	88.627
Sr+2	0.00016503	58.235	0.00011835	41.765
Zn+2	1.8357E-06	100	0	0

Westwater Injection Well Chemistry
Injection Water & Formation Water W181 Mixed 50/50: Precipitated Solids

Component	Total dissolved (molal)	% dissolved	Total precipitated (molal)	% precipitated
Ba+2	0.000004107	4.194	0.000093825	95.806
Ca+2	0.018197	94.303	0.0010993	5.697
Cl-1	0.55143	100	0	0
CO3-2	0.00035778	13.996	0.0021986	86.004
Fe+2	8.6844E-06	100	0	0
H+1	0.00025059	100	0	0
H3BO3	0.0010638	100	0	0
H4SiO4	0.000081787	74.867	0.000027456	25.133
K+1	0.0071817	100	0	0
Mg+2	0.054232	97.94	0.0011405	2.06
Mn+2	3.2764E-06	100	0	0
Na+1	0.44425	100	0	0
NH4+1	0.00067466	100	0	0
SO4-2	0.001785	95.006	0.000093825	4.994
Sr+2	0.00016503	100	0	0
Zn+2	1.8357E-06	100	0	0

Westwater Injection Well Chemistry
Injection Water & Formation Water W201 Mixed 50/50: Precipitated Solids

Component	Total dissolved (molal)	% dissolved	Total precipitated (molal)	% precipitated
Ba+2	1.5732E-06	0.811	0.0001924	99.189
Ca+2	0.017567	90.159	0.0019174	9.841
Cl-1	0.3822	100	0	0
CO3-2	0.00061176	24.188	0.0019174	75.812
Fe+2	8.7739E-06	100	0	0
H+1	0.00053664	100	0	0
H3BO3	0.0010638	100	0	0
H4SiO4	0.00010323	94.491	6.0181E-06	5.509
K+1	0.00066032	100	0	0
Mg+2	0.0070837	100	0	0
Mn+2	3.2764E-06	100	0	0
Na+1	0.32417	100	0	0
NH4+1	0.00067466	100	0	0
SO4-2	0.0028315	93.637	0.0001924	6.363
Sr+2	0.00016503	100	0	0
Zn+2	1.8357E-06	100	0	0

Westwater Injection Well Chemistry
Injection Water & Formation Water W181 Mixed 50/50: Saturation Indices

Mineral	log IAP	Sat. Index	Stoichiometry							
			1	Ca+2	1	SO4-2				
Anhydrite	-5.825	-1.447	1	Ca+2	1	SO4-2				
Aragonite	-8.506	-0.141	1	Ca+2	1	CO3-2				
Artinite	3.469	-5.824	-2	H+1	2	Mg+2	1	CO3-2	5	H2O
Ba(OH)2:8H2O	8.679	-15.577	1	Ba+2	10	H2O	-2	H+1		
Barite	-9.921	0	1	Ba+2	1	SO4-2				
Blanchite	-9.942	-8.175	1	Zn+2	1	SO4-2	6	H2O		
Brucite	12.405	-4.404	1	Mg+2	2	H2O	-2	H+1		
CaCO3xH2O	-8.512	-1.33	1	Ca+2	1	CO3-2	1	H2O		
Calcite	-8.506	0	1	Ca+2	1	CO3-2				
Celestite	-7.921	-1.306	1	Sr+2	1	SO4-2				
Chalcedony	-3.943	-0.443	1	H4SiO4	-2	H2O				
Chrysotile	29.336	-2.365	3	Mg+2	2	H4SiO4	1	H2O	-6	H+1
Cristobalite	-3.943	-0.644	1	H4SiO4	-2	H2O				
Dolomite (disordered)	-17.426	-0.768	1	Ca+2	1	Mg+2	2	CO3-2		
Dolomite (ordered)	-17.426	-0.235	1	Ca+2	1	Mg+2	2	CO3-2		
Epsomite	-6.277	-4.18	1	Mg+2	1	SO4-2	7	H2O		
Fe(OH)2 (am)	9.526	-3.73	1	Fe+2	2	H2O	-2	H+1		
Fe(OH)2 (c)	9.526	-3.364	1	Fe+2	-2	H+1	2	H2O		
Goslarite	-9.947	-7.972	1	Zn+2	1	SO4-2	7	H2O		
Greenalite	20.698	-0.112	-6	H+1	3	Fe+2	2	H4SiO4	1	H2O
Gypsum	-5.836	-1.229	1	Ca+2	1	SO4-2	2	H2O		
Halite	-1.307	-2.866	1	Na+1	1	Cl-1				
Huntite	-35.265	-5.022	3	Mg+2	1	Ca+2	4	CO3-2		
Hydromagnesite	-23.295	-13.972	5	Mg+2	4	CO3-2	-2	H+1	6	H2O
Hydrozincite	1.027	-7.07	5	Zn+2	2	CO3-2	-6	H+1	6	H2O
KCl	-4.04	-4.94	1	K+1	1	Cl-1				
Lime	12.824	-19.381	-2	H+1	1	Ca+2	1	H2O		
Magnesite	-8.92	-1.511	1	Mg+2	1	CO3-2				
Melanterite	-9.156	-7	1	Fe+2	1	SO4-2	7	H2O		
Mg(OH)2 (active)	12.405	-6.389	1	Mg+2	2	H2O	-2	H+1		
Mg2(OH)3Cl:4H2O	16.554	-9.446	2	Mg+2	1	Cl-1	-3	H+1	7	H2O
MgCO3:5H2O	-8.947	-4.407	1	Mg+2	1	CO3-2	5	H2O		
Mirabilite	-4.843	-3.931	2	Na+1	1	SO4-2	10	H2O		
MnCl2:4H2O	-7.415	-10.103	1	Mn+2	2	Cl-1	4	H2O		
MnCO3 (am)	-12.248	-1.748	1	Mn+2	1	CO3-2				
MnSO4	-9.567	-11.985	1	Mn+2	1	SO4-2				
Natron	-7.524	-6.381	2	Na+1	1	CO3-2	10	H2O		
Nesquehonite	-8.936	-4.204	1	Mg+2	1	CO3-2	3	H2O		
Periclase	12.411	-8.788	-2	H+1	1	Mg+2	1	H2O		
Portlandite	12.819	-9.557	1	Ca+2	2	H2O	-2	H+1		
Pyrochroite	9.077	-5.87	1	Mn+2	2	H2O	-2	H+1		
Quartz	-3.943	0	1	H4SiO4	-2	H2O				
Rhodochrosite	-12.248	-1.244	1	Mn+2	1	CO3-2				
Sepiolite	12.974	-2.496	2	Mg+2	3	H4SiO4	-4	H+1	-0.5	H2O
Sepiolite (A)	12.974	-5.806	-0.5	H2O	2	Mg+2	3	H4SiO4	-4	H+1
Siderite	-11.799	-1.19	1	Fe+2	1	CO3-2				
SiO2 (am,gel)	-3.943	-1.269	1	H4SiO4	-2	H2O				
SiO2 (am,ppt)	-3.943	-1.242	1	H4SiO4	-2	H2O				

Smithsonite	-12.59	-1.68	1	Zn+2	1	CO3-2				
Strontianite	-10.602	-1.33	1	Sr+2	1	CO3-2				
Thenardite	-4.788	-5.086	2	Na+1	1	SO4-2				
Thermonatrite	-7.474	-8.085	2	Na+1	1	CO3-2	1	H2O		
Vaterite	-8.506	-0.555	1	Ca+2	1	CO3-2				
Witherite	-12.602	-4.037	1	Ba+2	1	CO3-2				
Zincite	8.741	-2.261	1	Zn+2	1	H2O	-2	H+1		
Zincosite	-9.909	-13.628	1	Zn+2	1	SO4-2				
Zn(BO2)2	2.831	-5.459	-2	H2O	-2	H+1	1	Zn+2	2	H3BO3
Zn(OH)2 (am)	8.735	-3.52	1	Zn+2	2	H2O	-2	H+1		
Zn(OH)2 (beta)	8.735	-2.807	1	Zn+2	2	H2O	-2	H+1		
Zn(OH)2 (delta)	8.735	-3.109	1	Zn+2	-2	H+1	2	H2O		
Zn(OH)2 (epsilon)	8.735	-2.598	1	Zn+2	2	H2O	-2	H+1		
Zn(OH)2 (gamma)	8.735	-2.79	1	Zn+2	2	H2O	-2	H+1		
Zn2(OH)2SO4	-1.173	-8.673	-2	H+1	2	Zn+2	2	H2O	1	SO4-2
Zn2(OH)3Cl	9.236	-5.955	2	Zn+2	3	H2O	-3	H+1	1	Cl-1
Zn3O(SO4)2	-11.076	-29.332	-2	H+1	3	Zn+2	2	SO4-2	1	H2O
Zn4(OH)6SO4	16.298	-12.102	-6	H+1	4	Zn+2	6	H2O	1	SO4-2
Zn5(OH)8Cl2	27.207	-11.293	-8	H+1	5	Zn+2	8	H2O	2	Cl-1
ZnCl2	-7.734	-14.6	1	Zn+2	2	Cl-1				
ZnCO3	-12.59	-1.79	1	Zn+2	1	CO3-2				
ZnCO3:1H2O	-12.595	-2.335	1	Zn+2	1	CO3-2	1	H2O		
ZnSO4:1H2O	-9.914	-9.164	1	Zn+2	1	SO4-2	1	H2O		

Westwater Injection Well Chemistry

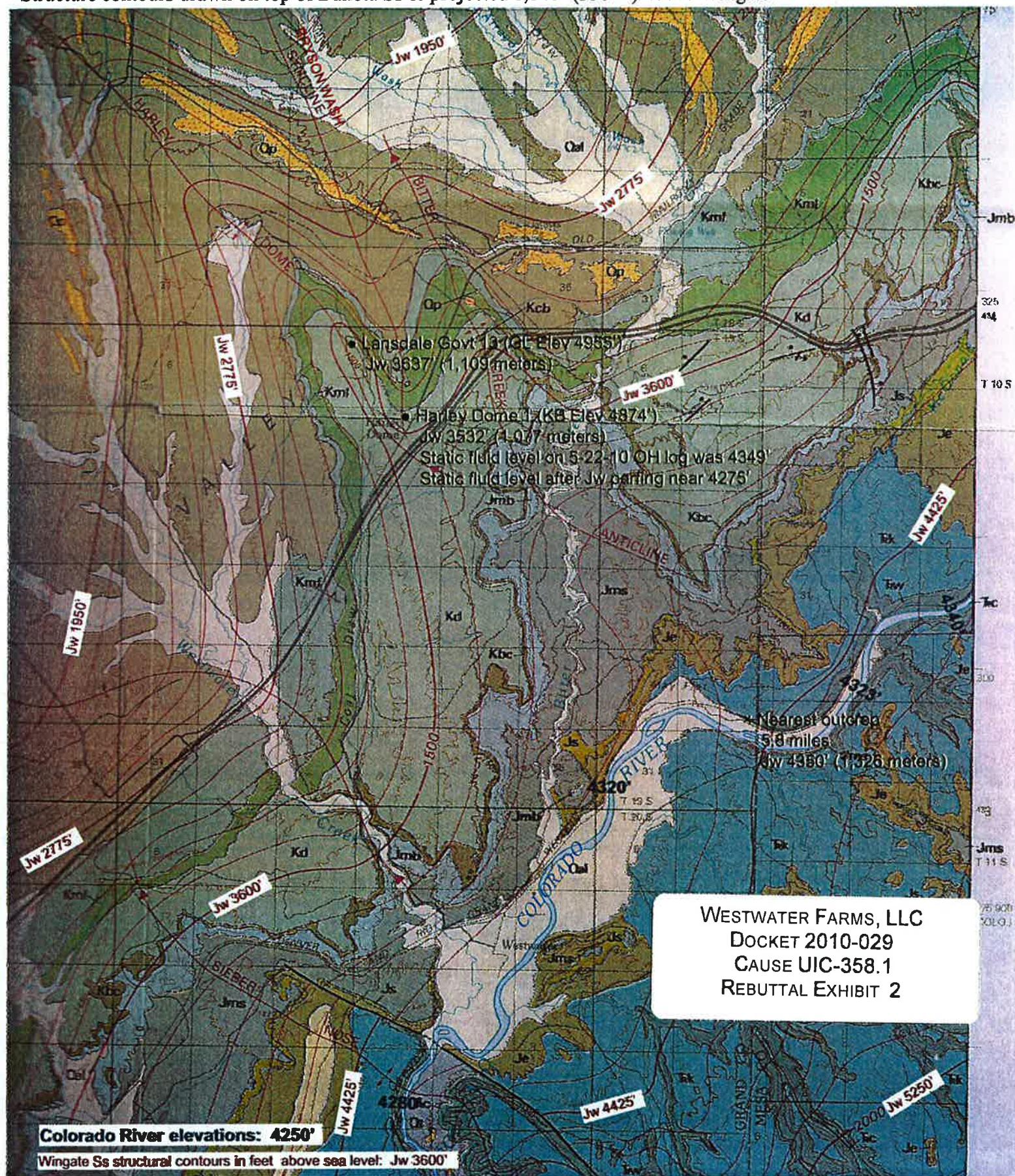
Injection Water & Formation Water W201 Mixed 50/50: Saturation Indices

Mineral	log IAP	Sat. Index	Stoichiometry							
			1	Ca+2	1	SO4-2				
Anhydrite	-5.825	-1.447	1	Ca+2	1	SO4-2				
Aragonite	-8.506	-0.141	1	Ca+2	1	CO3-2				
Artinite	3.469	-5.824	-2	H+1	2	Mg+2	1	CO3-2	5	H2O
Ba(OH)2:8H2O	8.679	-15.577	1	Ba+2	10	H2O	-2	H+1		
Barite	-9.921	0	1	Ba+2	1	SO4-2				
Blanchite	-9.942	-8.175	1	Zn+2	1	SO4-2	6	H2O		
Brucite	12.405	-4.404	1	Mg+2	2	H2O	-2	H+1		
CaCO3xH2O	-8.512	-1.33	1	Ca+2	1	CO3-2	1	H2O		
Calcite	-8.506	0	1	Ca+2	1	CO3-2				
Celestite	-7.921	-1.306	1	Sr+2	1	SO4-2				
Chalcedony	-3.943	-0.443	1	H4SiO4	-2	H2O				
Chrysotile	29.336	-2.365	3	Mg+2	2	H4SiO4	1	H2O	-6	H+1
Cristobalite	-3.943	-0.644	1	H4SiO4	-2	H2O				
Dolomite (disordered)	-17.426	-0.768	1	Ca+2	1	Mg+2	2	CO3-2		
Dolomite (ordered)	-17.426	-0.235	1	Ca+2	1	Mg+2	2	CO3-2		
Epsomite	-6.277	-4.18	1	Mg+2	1	SO4-2	7	H2O		
Fe(OH)2 (am)	9.526	-3.73	1	Fe+2	2	H2O	-2	H+1		
Fe(OH)2 (c)	9.526	-3.364	1	Fe+2	-2	H+1	2	H2O		
Goslarite	-9.947	-7.972	1	Zn+2	1	SO4-2	7	H2O		
Greenalite	20.698	-0.112	-6	H+1	3	Fe+2	2	H4SiO4	1	H2O
Gypsum	-5.836	-1.229	1	Ca+2	1	SO4-2	2	H2O		
Halite	-1.307	-2.866	1	Na+1	1	Cl-1				
Huntite	-35.265	-5.022	3	Mg+2	1	Ca+2	4	CO3-2		
Hydromagnesite	-23.295	-13.972	5	Mg+2	4	CO3-2	-2	H+1	6	H2O
Hydrozincite	1.027	-7.07	5	Zn+2	2	CO3-2	-6	H+1	6	H2O
KCl	-4.04	-4.94	1	K+1	1	Cl-1				
Lime	12.824	-19.381	-2	H+1	1	Ca+2	1	H2O		
Magnesite	-8.92	-1.511	1	Mg+2	1	CO3-2				
Melanterite	-9.156	-7	1	Fe+2	1	SO4-2	7	H2O		
Mg(OH)2 (active)	12.405	-6.389	1	Mg+2	2	H2O	-2	H+1		
Mg2(OH)3Cl:4H2O	16.554	-9.446	2	Mg+2	1	Cl-1	-3	H+1	7	H2O
MgCO3:5H2O	-8.947	-4.407	1	Mg+2	1	CO3-2	5	H2O		
Mirabilite	-4.843	-3.931	2	Na+1	1	SO4-2	10	H2O		
MnCl2:4H2O	-7.415	-10.103	1	Mn+2	2	Cl-1	4	H2O		
MnCO3 (am)	-12.248	-1.748	1	Mn+2	1	CO3-2				
MnSO4	-9.567	-11.985	1	Mn+2	1	SO4-2				
Natron	-7.524	-6.381	2	Na+1	1	CO3-2	10	H2O		
Nesquehonite	-8.936	-4.204	1	Mg+2	1	CO3-2	3	H2O		
Periclase	12.411	-8.788	-2	H+1	1	Mg+2	1	H2O		
Portlandite	12.819	-9.557	1	Ca+2	2	H2O	-2	H+1		
Pyrochroite	9.077	-5.87	1	Mn+2	2	H2O	-2	H+1		
Quartz	-3.943	0	1	H4SiO4	-2	H2O				
Rhodochrosite	-12.248	-1.244	1	Mn+2	1	CO3-2				
Sepiolite	12.974	-2.496	2	Mg+2	3	H4SiO4	-4	H+1	-0.5	H2O
Sepiolite (A)	12.974	-5.806	-0.5	H2O	2	Mg+2	3	H4SiO4	-4	H+1
Siderite	-11.799	-1.19	1	Fe+2	1	CO3-2				
SiO2 (am,gel)	-3.943	-1.269	1	H4SiO4	-2	H2O				
SiO2 (am,ppt)	-3.943	-1.242	1	H4SiO4	-2	H2O				

Smithsonite	-12.59	-1.68	1	Zn+2	1	CO3-2				
Strontianite	-10.602	-1.33	1	Sr+2	1	CO3-2				
Thenardite	-4.788	-5.086	2	Na+1	1	SO4-2				
Thermonatrite	-7.474	-8.085	2	Na+1	1	CO3-2	1	H2O		
Vaterite	-8.506	-0.555	1	Ca+2	1	CO3-2				
Wltherite	-12.602	-4.037	1	Ba+2	1	CO3-2				
Zincite	8.741	-2.261	1	Zn+2	1	H2O	-2	H+1		
Zincosite	-9.909	-13.628	1	Zn+2	1	SO4-2				
Zn(BO2)2	2.831	-5.459	-2	H2O	-2	H+1	1	Zn+2	2	H3BO3
Zn(OH)2 (am)	8.735	-3.52	1	Zn+2	2	H2O	-2	H+1		
Zn(OH)2 (beta)	8.735	-2.807	1	Zn+2	2	H2O	-2	H+1		
Zn(OH)2 (delta)	8.735	-3.109	1	Zn+2	-2	H+1	2	H2O		
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ZnSO4·1H2O	-9.914	-9.164	1	Zn+2	1	SO4-2	1	H2O		

Relative Elevations of the Top of the Wingate Sandstone and Distance to Nearest Outcrop

Harley Dome Anticline, Harley Dome 1 UIC Permit Site (Bryson Wash Syncline) and Westwater Canyon Area
 Westwater 30' x 60' Geologic Quad Map, USGS Map I-1765 (1988), Scale 1:100,000 w/notes by David L. Allin
 Structure contours drawn on top of Dakota Ss & projected 1,148' (350 m) above Wingate Ss where Dakota is absent



One Mile

Relative Elevations of the Top of the Wingate Sandstone and Distance to Nearest Outcrop
 Harley Dome Anticline, Harley Dome 1 UIC Permit Site (Bryson Wash Syncline) and Westwater Canyon Area
 Map Base: Grand Junction 1° x 2° Geologic Quad Map, USGS Map I-736 (1973), Scale 1:250,000
 Structure contours revised to represent top of Wingate Ss
 Revisions by David L. Allin December 1, 2010

